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TECHNICAL MEMORANDUM  
UPPER AQUIFER INVESTIGATION  
(PHASE II)  
WELL INSTALLATION AND SAMPLING

AMERICAN CHEMICAL SERVICE, INC.  
NPL SITE  
GRIFFITH, INDIANA

PREPARED FOR:  
ACS RD/RA EXECUTIVE COMMITTEE

...  
PREPARED BY:  
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MARCH 1997



MONTGOMERY WATSON



Ms. Sheri Bianchin, RPM  
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Dear Ms. Bianchin:

The previous copies of the Technical Memorandum were provided in three-ring binders to facilitate the revision process. The following items are attached to update the reports previously submitted to the U.S. EPA.

- Five Replacement Covers
- Five copies of Technical Memorandum Text, including the Table of Contents
- Five copies of Table 7
- No Figures are attached because none were changed
- Five copies of Appendix G
- Five copies of the Montgomery Watson's Response to Comments cover letter
- One copy of the redlined text, with cross references to each U.S. EPA comment in the left margin

Sincerely,

John VA  
for

cc: H. Grejda, IDEM (2 copies of enclosures)  
S. Mrkvika, B&V (2 copies of enclosures)  
ACS Technical Committee (1 copy each of enclosures)

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## INTRODUCTION

This Technical Memorandum summarizes the investigation activities and results of the second phase of the Upper Aquifer Investigation conducted at the American Chemical Service, Inc. NPL site in Griffith, Indiana during July and August 1996. The investigation was conducted in accordance with the July 25, 1996 Upper Aquifer Investigation Monitoring Well Installation and Sampling Proposal. Specific Operating Procedures (SOPs) were approved with modifications by the U.S. EPA on June 28, 1996. Investigation activities were also conducted in accordance with the draft Quality Assurance Project Plan (QAPP) and U.S. EPA comments regarding the QAPP.

The purpose of this second phase of the Upper Aquifer Investigation was to install and sample monitoring wells at the site to confirm the approximate extent of groundwater contamination in the upper aquifer delineated by the first phase of the Upper Aquifer Investigation. The first phase of the Upper Aquifer Investigation consisted of a Geoprobe investigation conducted at the ACS site from February through March 1996. Shallow groundwater samples were collected from 110 temporary sampling points (i.e., hydraulic probes) and analyzed with a field gas chromatograph (GC) for a target list of VOCs. The extent of total VOC detections in the upper aquifer delineated by the Geoprobe investigation is shown in Figure 1.

Based on the results of the Geoprobe investigation, 13 monitoring wells, eight piezometers and two staff gauges were installed in the upper aquifer at locations around the perimeter of the ACS site and used to characterize shallow groundwater flow directions and delineate the extent of groundwater contamination in the upper aquifer. The locations of monitoring wells, piezometers and staff gauges installed during the second phase of Upper Aquifer Investigation are shown on Figure 1.

### 1.1 OBJECTIVES

Specific objectives of the Upper Aquifer Investigation included:

1. Verifying the depth to the upper confining clay layer at each well and piezometer location and adding to the database of upper clay surface elevations measured at the site.

2. Confirming the extent of groundwater contamination at the site delineated by the Geoprobe investigation.
3. Evaluating vertical hydraulic gradients in the upper aquifer within the wetlands area west of the facility.
4. Refining the shallow groundwater flow patterns previously delineated at the site.

## **1.2 SCOPE OF WORK**

The following activities were completed to meet the objectives of the Upper Aquifer Investigation:

- Thirteen monitoring wells and eight piezometers were installed in the upper aquifer.
- Two staff gauges were installed north of the Grand Trunk railroad.
- Newly installed monitoring wells were developed and sampled and groundwater samples were analyzed for full scan TCL organics and TAL metals.
- Water levels were measured in all upper aquifer wells and piezometers located at the site.

## Field Activities

### 2.1 DRILLING AND WELL INSTALLATION

#### 2.1.1 Monitoring Well and Piezometer Borings

Prior to initiating drilling activities, the locations of monitoring wells and nested piezometers were staked by Montgomery Watson and a U.S. EPA representative.

Monitoring well and piezometer borings were drilled utilizing an all-terrain, track-mounted drill rig equipped with 4.25 inch inner diameter (ID) hollow stem augers (HSA). Soil samples were collected using a 2-inch diameter split-spoon sampler at 2.5 foot intervals (i.e., 0 to 2.5 ft, 2.5 to 5 ft, etc.) to the top of the upper confining clay. One soil sample was then collected two feet into the clay, to confirm the presence of the upper confining clay layer.

Each boring was logged in accordance with the Unified Soil Classification System (USCS). Drilling was conducted in accordance with the approved Monitoring Well Sampling Proposal and SOP for the Upper Aquifer Investigation (revision: July 25, 1996) with the following exceptions:

- Monitoring well (MW41) was not installed in the original staked location because the water table at this location was present in the upper confining clay rather than the upper aquifer. Several exploratory boreholes were drilled in the area to identify where the upper aquifer was thicker so that the proposed monitoring well could be installed along the eastern edge of the VOC plume. The final location of well MW41 was approved by U.S. EPA and is approximately 60 feet south from the original staked location.

Locations of new monitoring wells, piezometers, and staff gauges are presented on Figure 1. Monitoring well and piezometer construction information is summarized on Table 1. Boring logs for upper aquifer monitoring wells and piezometers are included in Appendix A

#### 2.1.2 Monitoring Well and Piezometer Installation

Thirteen monitoring wells (MW37 through MW49) were installed to further delineate the extent of VOC contamination in the upper aquifer (Figure 1). Monitoring well MW45,

located in the southeast area of the site, and MW48 and MW49, located north of the site, were installed within the known extent of the VOC plume. The remaining ten monitoring wells were installed along the edge of the VOC plume, as defined during the Geoprobe investigation.

All monitoring wells were installed using a 10-foot, 0.010 slot, stainless steel well screen, stainless steel riser, and steel protective casing and lock in accordance with the approved SOP. If soil borings during well installation activities had indicated a saturated thickness greater than 15 feet, two wells would have been installed at that location, one well consisting of a 10-foot well screen at the water table, and another well at the base of the aquifer. Because the saturated thickness encountered at all locations was less than 15 feet, a single upper aquifer well was installed at each location. In areas where the water table was high (i.e., standing water in the wetlands), the well was installed in a manner to assure a proper and adequate seal above the well screen, in accordance with the SOP presented in the Upper Aquifer Investigation Technical Memorandum and Monitoring Well Sampling Proposal and Protocols (revised July 25, 1995).

Eight piezometers (P64 through P71) were installed at four locations (two nested at each location) in the wetlands, west of the ACS facility (Figure 1). The deep piezometer at each location was installed with a 2.5 foot PVC well screen and riser pipe at the base of the upper aquifer (top of the upper confining clay). The shallow piezometer at each location was installed with a 5 foot PVC screen and riser in the upper portion of the aquifer which intersected the water table.

Well construction details for the monitoring wells and piezometers are presented in Appendix B. Monitoring well and piezometer installation was conducted in accordance with the approved Monitoring Well Sampling Proposal and Protocol SOP for the Upper Aquifer Investigation (revision: July 25, 1996).

### **2.1.3 Staff Gauge Installation**

Two staff gauges (SG11 and SG12) were installed in the ditch to the north of the Grand Trunk railroad and the ACS facility to document surface water elevations and aid in evaluating groundwater flow information north of the site. The staff gauge locations are presented on Figure 1.

## **2.2 MONITORING WELL DEVELOPMENT AND SURVEYING**

Following installation of the monitoring wells in the upper aquifer, the wells were developed on July 18-19, 1996 in accordance with the approved Monitoring Well Sampling Proposal and Protocol SOP for the Upper Aquifer Investigation (revision: July 25, 1996). Monitoring well development information is presented in Appendix C.

Monitoring wells and piezometers were later surveyed by Area Survey of Orland Park, Illinois. Survey information, ground surface and casing elevations, and local coordinates

(northing and easting) for the 13 new monitoring wells, eight piezometers, and two staff gauges are presented in Appendix D.

## **2.3 WATER LEVELS**

To determine the groundwater flow direction in the upper aquifer and vertical gradients in the wetlands, water level measurements were made at new and existing upper aquifer wells and piezometers on August 27, 1996.

## **2.4 MONITORING WELL SAMPLING**

Prior to sampling, monitoring wells were purged using low-flow methods in accordance with the approved Monitoring Well Sampling Proposal and Protocol SOP for the Upper Aquifer Investigation (revision: July 25, 1996). Field parameters for pH, specific conductivity, temperature, and turbidity were measured and recorded during well purging activities. A summary of groundwater sampling field parameter data is presented on Table 2.

New upper aquifer monitoring wells were sampled between August 5 and 8, 1996 and analyzed for full scan TCL volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), polychlorinated byphenols (PCBs) and TAL inorganic parameters. Monitoring well sampling was performed in accordance with the approved Monitoring Well Sampling Proposal and Protocol SOP for the Upper Aquifer Investigation (revision: July 25, 1996).

## **2.5 PRIVATE WELLS**

Identification and sampling of private wells in the vicinity of the ACS site are discussed in the September 1996 Lower Aquifer Investigation Report.

## HYDROGEOLOGY OF THE UPPER AQUIFER

### 3.1 GEOLOGY

Boring logs generated during phase 2 of the Upper Aquifer Investigation are presented in Appendix A. Soils of the upper aquifer are generally classified as fine to coarse sand with a trace to some silt and clay. The soils were classified with the United Soil Classification System (USCS) symbols of SP, SP-SM, and SM (Appendix A). The thickness of the upper aquifer encountered during this investigation ranged from approximately 11 feet at several locations to 18 feet at MW43 (Table 1). More information on the geology and thickness of the upper aquifer is presented in the June 1991 Remedial Investigation (RI) Report and in the September 1996 Lower Aquifer Investigation Report. Investigations to date indicate that the upper aquifer thickness ranges between approximately 13 and 28 feet across the Site.

The top of the upper clay confining layer was confirmed at all monitoring well and piezometer locations. The upper surface of clay confining layer was encountered typically at an elevation near 620 feet above mean sea level (amsl) (Table 1). More variability in the elevation of the top of the clay confining layer was found in the southeast portion of the site, where the upper clay surface ranged from approximately 613 feet amsl at MW43 to 624 feet amsl at MW47. In other areas of the site, the top of the clay confining layer ranged from 618 feet to 623 feet amsl (Table 1). The elevations of the top of the upper clay confining layer determined with this investigation are consistent with the findings of previous investigations and expand the data base regarding the upper clay surface elevation at the site. The clay confining layer is generally classified with a USCS symbol of CL (Appendix A).

The geology of the upper aquifer and depth to the upper clay confining layer are consistent with the findings of the June 1991 RI and the Lower Aquifer and Barrier Wall Investigations recently performed at the site (January through March 1996).

## **3.2 HYDROGEOLOGY**

### **3.2.1 Water Levels**

Water levels were measured at new and existing upper aquifer monitoring wells, piezometers, and staff gauges on August 27, 1996. The measured water level depths and calculated groundwater elevations are presented on Table 3.

Depth to water in the upper aquifer monitoring wells ranged between 3.31 feet below top of casing (toc) in MW19 to 21.39 feet below toc in MW6. The groundwater elevation in the upper aquifer ranged from 637.04 feet amsl at MW18 to 625.42 amsl at M-3S located at the Griffith landfill. The saturated thickness of the upper aquifer ranged from 13.7 feet at MW43 to 7.4 feet at MW45.

Two staff gauges installed in the ditch north of the Grand Trunk Railroad and the ACS facility were dry when measured on August 27, 1996. Staff gauge SG-9, which is presently missing at the Site, will be re-installed prior to the next water level measurement event.

### **3.2.2 Groundwater Flow Direction**

The water table as measured on August 27, 1996 is depicted on Figure 2. Based on the August 1996 data, the direction of shallow groundwater flow in the upper aquifer is generally to the west in the area west of Colfax Avenue and southeast in the area southeast of the intersection of Colfax Avenue and Reder Road.

The westward orientation of shallow groundwater flow lines at the ACS plant is directed towards the wetland area and dewatering activities in the northwestern corner of the Griffith landfill. Southeast of the intersection of Colfax Avenue and Reder Road, the direction of groundwater flow in the upper aquifer appears to mimic the topography in the area. Groundwater flow in the upper aquifer follows the slope of the land surface to the southeast (Figure 2).

The direction of horizontal groundwater flow in the upper aquifer is consistent with upper aquifer data presented in the June 1991 RI and recent water level data collected on October 30, 1995 and June 5, 1996. Water table maps generated from these two measurement periods were presented in the November 8, 1995 Technical Memorandum and the July 16, 1996 Water Level Memorandum, respectively.

### **3.2.3 Vertical Gradients in Wetlands**

A summary of vertical hydraulic gradients measured in nested piezometers in the wetland area on August 27, 1996 is presented on Table 4. Vertical gradients in the wetland area were generally very low showing little difference in hydraulic head between the upper and lower portions of the upper aquifer. Vertical gradients were upward at P64/P65 (0.009) and P66/P67 (0.005), downward at P70/P71 (0.020) and non-existent at P68/P69 (0.000) (Table 4). Upward gradients observed at the two southern piezometer nests indicate that groundwater is discharging to the wetland in this area of the site. The downward gradient measured at P70/P71 indicates some groundwater movement downward from the upper

portions of the aquifer to the lower in this area. Approximately 150 feet west of the P70/P71 piezometer nest, no vertical gradients were measured at piezometer nest P68/P69. The vertical gradient information is consistent with a typical wetland area where shallow groundwater is in close contact with surface water and shallow groundwater recharge and discharge to the wetland fluctuate throughout the year as the water table periodically rises and falls in the area.

## ANALYTICAL RESULTS

New upper aquifer monitoring wells were sampled at the site between August 5 to 8, 1996 for VOCs, SVOCs, PCBs and metals. Laboratory analytical results for VOCs, SVOCs and PCBs are presented in Appendix E. Laboratory analytical results for metals are included in Appendix F.

Overall, concentrations of VOCs measured in new monitoring wells confirm the edge of the VOC plume delineated by the Geoprobe investigation (Figure 1). Detections of SVOCs in monitoring wells correlate with detections of VOCs, whereas concentrations of total and dissolved trace metals appear to be randomly distributed in new monitoring wells.

### 4.1 VOC RESULTS

A summary of VOC detections in new monitoring wells installed at the ACS site is presented in Table 5. VOCs were detected at monitoring wells MW37, MW39, MW45, MW46, MW48 and MW49 (Table 5). Figure 3 summarizes the VOC detections in site monitoring wells.

#### 4.1.1 North Side

The highest concentrations of VOCs were detected at monitoring wells MW48 and MW49 which were located within the known boundaries of the VOC plume in the northern area of the site. Benzene and methylene chloride were detected in MW48 at concentrations of 9,100 µg/L and 70(J) µg/L, respectively, and in MW49 at concentrations of 5,000 µg/L and 70(J) µg/L, respectively. These concentrations of benzene and methylene chloride exceed site remediation levels. Also in the northern area of the site, benzene and vinyl chloride were detected at MW39 at concentrations of 12 µg/L and 0.9(J) µg/L, respectively, which exceed remediation levels for the final remedy (Table 5). VOCs were not detected at MW38 and benzene was found at an estimated quantity of 0.1(J) µg/L at MW37. Considering the western orientation of shallow groundwater flow in this area of the site (Figure 2), monitoring wells MW38 and MW37 bound the limits of VOC contamination north of the site. Although the benzene concentration of 12 µg/L at MW39 exceeds the site remediation level for benzene, the concentration is very low compared to concentrations within the plume as shown at MW48 and MW49. Therefore, the VOC detections at MW39 indicate that the edge of the plume has been identified.

#### **4.1.2 East Side**

East of the site, VOCs were not detected at MW40. This is consistent with the results of the Geoprobe investigation which did not identify any target VOC concentrations in the upper aquifer in this area of the site.

#### **4.1.3 Southeast Area**

Southeast of the site, VOCs, including benzene (530 µg/L), xylenes (60 µg/L), chloroethane (82(J) µg/L), chlorobenzene (16(J) µg/L) and ethylbenzene (10(J) µg/L) were detected in the monitoring well in the center of the plume area (MW45) (Table 5). The concentration of benzene detected at MW45 (530 µg/L) exceeded the remediation level of 5 µg/L listed in Appendix B of the SOW. The remaining wells in this area (MW41 through MW44, and MW47) did not exhibit any VOC contamination and subsequently surround the VOC detections observed in MW45. The concentration of benzene observed in monitoring well MW45 (530 µg/L) correlates to the concentration observed in the same area during the Geoprobe investigation (1100 µg/L at GP134). The lack of VOC detections in monitoring wells surrounding MW45 is also consistent with the Geoprobe investigation since these surrounding monitoring wells were located in non-contaminated areas delineated by the Geoprobe investigation.

#### **4.1.4 Wetland Area to the West**

West of the site, concentrations of vinyl chloride (0.2(J) µg/L), benzene (0.8(J) µg/L and 4-methyl-2-pentanone (3(J) µg/L) were detected at monitoring well MW46 (Table 5) but at such low levels they were only estimated. This was consistent with the results of the Geoprobe investigation which indicated no significant VOC migration in groundwater located beyond the edge of the wetland.

Acetone was not detected in any of the monitoring well samples. This is contrary to the results of the Geoprobe investigation which found low levels of acetone (less than 50 µg/L) in Geoprobe samples from many sampling points near the leading edge of the VOC plume. Because the acetone detections in the Geoprobe investigation samples were not confirmed by the more definitive monitoring well samples, it is likely that the low levels of acetone (less than 50 µg/L) measured in the hydraulic probe investigation were anomalous, possibly the result of instrument cross-contamination during the field GC analysis.

### **4.2 SVOCs AND PCBs RESULTS**

A summary of SVOC results detections in new monitoring wells installed at the ACS site is presented in Table 5. Laboratory analytical reports for SVOC and PCB results are presented in Appendix E.

SVOC compounds were generally detected in the same monitoring wells exhibiting VOC contamination. Highest SVOC concentrations were found in monitoring wells MW48 and

MW49, located within the limits of known groundwater contamination in the northern area of the site, and MW45, located in the central portion of the VOC plume in the southeast area of the site. Phenol was generally detected at the highest concentrations in these wells, ranging from 41 µg/L at MW45 to 110 µg/L at MW48 (Table 5). Bis-2-chloroethyl-ether (7 µg/l), naphthalene (84 µg/l), and 2-methylnaphthalene (4 µg/l) were also detected in MW45 and estimated concentrations of bis-2-chloroethyl-ether and 4-methylphenol were detected at MW46.

Bis-2-ethylhexyl-phthalate was detected at estimated concentrations in monitoring wells MW39, MW41, MW42, MW46, and MW48 at concentrations ranging between 3 µg/L and 8 µg/L (Table 5). The concentration of bis-2-ethylhexyl-phthalate at MW41 (8 J µg/L) exceeded the remediation level established for the site (5.8 µg/L). This compound is a common laboratory contaminant which is commonly used in the production of plastics, such as polyvinyl chloride (*Handbook of Environmental Data on Organic Chemicals, Second Edition*, Verschueren, 1983). The phthalates anomaly will be further evaluated in the site monitoring program.

No SVOCs were detected in monitoring wells MW37, MW38, MW40, MW42, MW43, and MW44. Tentatively identified compounds (TICs) were detected in samples at all wells except MW37, MW42, MW43, and MW44 (Appendix E). The greatest number of TICs and highest estimated concentrations were found in samples collected at MW48 and MW49.

PCBs were not detected in any of the groundwater samples collected during the Upper Aquifer Investigation.

#### 4.3 METALS RESULTS

A summary of metals results is presented on Table 6. Complete validated metal analytical results are presented in Appendix F.

Groundwater samples from new upper aquifer wells were analyzed for both total and dissolved metals (Table 6). Major groundwater constituents, calcium, magnesium, and sodium were generally detected at the highest concentrations in the upper aquifer, followed by detections of minor metals constituents, manganese, potassium and aluminum (Table 6).

Other metals apparently randomly located in upper aquifer monitoring wells included arsenic, barium, beryllium, cadmium, lead, nickel and thallium (Table 6). Arsenic and barium were found in many of the upper aquifer wells; concentrations of arsenic (dissolved) ranged from 1.5 µg/L at MW42 to 25.5 µg/L at MW49, and barium concentrations ranged from 18.5 µg/L at MW41 to 164 µg/L at MW44. Beryllium was detected in two monitoring well samples (MW37 and MW40) at concentrations less than 0.32 µg/L. Cadmium was detected in total and dissolved samples collected at MW37

(dissolved concentration of 0.24 µg/L) and a total metals sample at MW47 (0.2 µg/L). Lead was detected at MW47 at a dissolved concentration of 20 µg/L and a total metals concentration of 38.5 µg/L at MW45. Nickel and thallium were found in a total metals sample collected at MW39; thallium was also detected at MW48 at 1.2 µg/L (Table 6).

Concentrations of arsenic detected at MW43, MW45, MW48 and MW49, beryllium detected at MW37 and MW40, and thallium at MW39 and MW48 exceeded the remediation levels for these constituents listed in Appendix B of the SOW. The random detections of these metals at various monitoring wells at the site suggest that the metal detections are naturally occurring background concentrations.

Due to the low turbidity achieved with the low flow sampling, most total metals analyses are directly comparable to dissolved analyses (Table 6). Aluminum and iron (abundant clay mineral constituents) appear to be most variable between dissolved and total groundwater samples.

## CONCLUSIONS AND RECOMMENDATIONS

### 5.1 CONCLUSIONS

The following conclusions are based on data developed from the second phase of Upper Aquifer Investigation:

1. The upper aquifer consists of predominantly fine to coarse sand and vary in thickness from approximately 13 feet to 18 feet. The saturated thickness of the upper aquifer ranged from 13.7 feet at MW43 to 7.4 feet at MW45.
2. The top of the upper confining clay was found at elevations ranging from 613 feet at MW43 to 624 feet amsl at MW47. This range of elevations is consistent with the results of previous investigations and adds to the database of upper clay surface elevation measured at the site.
3. The direction of horizontal groundwater flow in the upper aquifer is generally to the west at the ACS facility toward the wetland area and dewatering activities in the northwestern corner of the Griffith landfill. Southeast of the intersection of Colfax Avenue and Reder Road, the horizontal direction of groundwater flow is to the southeast. The horizontal groundwater flow direction is consistent with upper aquifer data presented in the June 1991 RI and recent water level data collected on October 30, 1995 and June 5, 1996.
4. Vertical gradients in the wetland area were generally very low and variable between the upper and lower portions of the upper aquifer, ranging from 0.009 upward to 0.020 downward. The vertical gradient information is consistent with a typical wetland area where shallow groundwater is in close contact with surface water and shallow groundwater recharge and discharge to the wetland fluctuate throughout the year as the water table periodically rises and falls in the area.
5. North of the ACS facility, benzene, methylene chloride and vinyl chloride were detected in upper aquifer monitoring wells above remediation levels. The highest concentrations of VOCs were detected at monitoring wells MW48 and MW49 which were located within the known boundaries of the VOC plume in the northern area of the site. Based on the western orientation of shallow groundwater flow in this area of

the site (Figure 2), monitoring wells MW37, MW38 and MW39 bound the limits of VOC contamination north of the site.

6. VOCs were not detected in the upper aquifer monitoring well (MW40) installed east of the facility. This is consistent with the results of the Geoprobe investigation which did not identify any target VOC concentrations in this area of the site.
7. West of the site, trace concentrations of VOCs were estimated in the water from one monitoring well (MW46). This is consistent with the results of the Geoprobe investigation which indicated no significant contaminant migration beyond the edge of the wetland.
8. Southeast of the intersection of Colfax Avenue and Reder Road, benzene was detected in one monitoring well (MW45) exceeding the site remediation level. MW45 is located inside the known limits of the VOC plume. The other wells in this area surround the VOC plume and provide delineation of the extent of groundwater contamination.
9. Bis-2-ethylhexyl-phthalate was detected at an estimated concentration in one monitoring well exceeding the site remediation level. This compound is a suspected laboratory contaminant. Its significance at the site will be evaluated in the site monitoring plan. No other SVOCs were detected in upper aquifer wells exceeding the remediation levels.
10. Major and minor groundwater metal constituents were detected most frequently in the upper aquifer. Other metals randomly detected in upper aquifer monitoring wells included arsenic, barium, beryllium, cadmium, lead, nickel and thallium.
11. The concentration of benzene detected at MW39 at the northeast area of the site (12 µg/L) exceeded the site remediation level. Because monitoring well MW39 was located at the edge of VOC detections delineated by the Geoprobe investigation, the low concentrations detected in this well are consistent with the Geoprobe investigation results and indicate the edge of the VOC plume.

## **5.2 RECOMMENDATIONS OF PHASE II UPPER AQUIFER INVESTIGATION**

### **5.2.1 Piezometer Installation**

The piezometer P57 will be installed in the northeast area to confirm groundwater flow patterns in this area of the site. The location of proposed piezometer P57 is shown on Figure 4.

### **5.2.2 Upper Aquifer Monitoring Plan**

Monitoring wells installed during the second phase of upper aquifer investigation delineate the horizontal extent of groundwater contamination at the ACS site. These wells will be added to the upper aquifer monitoring plan to provide indications of compliance or contaminant migration in the upper aquifer.

## UPPER AQUIFER MONITORING PLAN

### 6.1 INTRODUCTION

This monitoring plan proposes the well locations and sampling parameters for upper aquifer quarterly monitoring activities at the ACS site. The monitoring plan includes collecting water level measurements at the upper aquifer monitoring wells, piezometers, and staff gauges and water quality baseline sampling at 20 upper aquifer wells starting in October 1996. In addition, the plan includes annual sampling of four interior plume wells, and three Griffith landfill wells.

The first round of sampling for the baseline consisted of the full-scan sampling of new upper aquifer wells conducted in August 1996 and the proposed sampling of selected existing upper aquifer wells in October 1996. The second round of sampling will consist of 24 upper aquifer monitoring wells as listed in Table 7 and 24 lower aquifer monitoring wells as listed in Table 14 of the Lower Aquifer Technical Memorandum. All sampling will be conducted in accordance with U.S. EPA approved Specific Operating Procedures (SOPs). A SOP for low flow sample collection is included as Appendix G.

The objectives of the Upper Aquifer Monitoring Plan include the following:

1. Monitor groundwater quality at the boundaries of the known extent of contamination to determine whether the contaminant plume in the upper aquifer is remaining constant or expanding.
2. Measure water levels in the upper aquifer to determine how remedial actions will affect groundwater flow patterns at the site.
3. For remedial design information, monitor groundwater quality in the plume interior to determine how contaminant concentrations change in response to remedial actions.

The locations of monitoring wells proposed for the upper aquifer monitoring plan are shown on Figure 4. To facilitate review of the plan, the locations of the proposed monitoring wells have been grouped on Table 7 according to their location in the north, east, southeast, southwest, wetland or plume interior areas of the site. Each of these areas are discussed separately below.

## **6.2 SAMPLING LOCATIONS**

### **6.2.1 North Area**

Three new monitoring wells are included in the monitoring plan for the northern area of the site (Figure 4). These wells, MW37, MW38, and MW39 bound the limits of VOC contamination north of the site and will provide evidence whether the plume is remaining constant or expanding in this area.

### **6.2.2 East Side**

Four monitoring wells, including one new well (MW40) and three existing wells (MW11, MW12 and MW18) will comprise the baseline sampling points for the eastern portion of the site. These wells are generally located side-gradient in the upper aquifer to the ACS Site and will bound the limits of VOC contamination east of the site.

Monitoring wells MW4, MW5 and MW17 are not included in the upper aquifer monitoring plan. These wells are within the known limits of the contaminant plume east of the site.

### **6.2.3 Southeast Area**

Baseline monitoring in the southeast area will include the five new wells installed during the upper aquifer investigation (MW41, MW42, MW43, MW44, and MW47) and existing monitoring well MW19. These wells surround the VOC detections delineated by the Geoprobe investigation and will monitor potential plume migration in the upper aquifer downgradient from the landfill area.

Monitoring well MW20 is not included in the upper aquifer monitoring plan because it is located within the known limits of the contaminant plume and because of its proximity to MW19. MW6 and MW45 have been included in this area to monitor the interior of the plume (see Section 6.2.6).

### **6.2.4 Southwest Area**

Monitoring well, MW15 and Griffith Landfill wells M-1S, M-3S, and M-4S, will serve as sentinel wells southwest of the Site to monitor potential contaminant migration southwestward from the landfill.

### **6.2.5 Wetland Area**

Three monitoring wells, including one new well (MW46) and two existing wells (MW13 and MW14) will monitor potential VOC migration into the wetland area west of the ACS facility.

Monitoring wells MW2 and MW3 are not included in the upper aquifer monitoring plan because these wells are located within the known limits of the contaminant plume in the wetland area of the site. Well W-1 is not included because it was installed prior to the RI and has not been previously used as a monitoring point for the NPL Site.

### **6.2.6 Plume Interior**

Four monitoring wells located within the known limits of contamination will be sampled on an annual basis to measure the behavior of contaminant concentrations within the plume over time. Two wells are located in the northern area of the plume (MW48, MW49) and two wells are located within the plume southeast of the landfill (MW6, MW45).

## **6.3 SAMPLE ANALYSIS**

During the first quarter (August and October 1996 combined), all groundwater samples from the designated upper aquifer monitoring wells were analyzed for full-scan Target Compound List (TCL) and Target Analyte List (TAL) parameters (Table 7). In the first quarter of 1997, groundwater samples collected from the north, east, southeast, southwest, and wetland areas of the site will be analyzed for full scan TCL and TAL parameters (Table 7). The analytical from this event will be evaluated, and a meeting with U.S. EPA will be scheduled to discuss the analytical requirements for sampling during the second and third quarters of 1997 (rounds 3 and 4, respectively). These four consecutive quarters of monitoring will form the baseline data base for the monitoring program.

Groundwater samples from plume interior wells will be sampled for TCL analyses. Because these wells are known to be contaminated, the purpose of monitoring concentrations in these wells is to detect how the contaminant concentrations change over an extended period of time. Monitoring these wells on a quarterly basis would not allow sufficient time for changes to occur and show concentration trends. Variability observed in concentrations over a three month period may be more indicative of analytical variability than actual changing concentration conditions. Further, upon completion of the barrier wall and perimeter groundwater containment system, the upper aquifer groundwater flow will be in a transition period, establishing a new flow regime.

## **6.4 PROCEDURES**

### **6.4.1 Water Level Measurements**

Water levels will be collected at all monitoring wells, piezometers and staff gauges in the upper aquifer prior to sampling the selected wells. Water levels will be collected in a

single day to minimize potential water level variability with time (as part of the overall site monitoring plan, water levels measurements will be collected in the lower aquifer wells and piezometers within the same 24-hour period as water levels measurements in the upper aquifer).

#### **6.4.2 Monitoring Well Sampling**

Prior to sampling, all monitoring wells will be purged and sampled using low-flow methods in accordance with the approved Monitoring Well Sampling Proposal and Protocol SOP for the Upper Aquifer Investigation (revision: March 1997). A copy of the approved SOP is included in Appendix G. Field parameters for pH, specific conductance, temperature and turbidity will be measured and recorded during well purging. Sampling activities will be conducted in a typical period of one week.

### **6.5 SAMPLING SCHEDULE**

The 24 upper aquifer monitoring wells listed on Table 7 and the 24 lower aquifer monitoring wells tested in the Lower Aquifer Technical Memorandum (Table 14) will be sampled at the end of March 1997. The sampling results will be reported at the beginning of June 1997. The third and fourth sampling rounds will be collected during the second and third quarters of 1997, following a meeting with U.S. EPA to discuss required analyses for these rounds.

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**Table 7**  
**Upper Aquifer Sampling Plan**  
**American Chemical Service, Inc. NPL Site**  
**Griffith, Indiana**

	Area of Site	Well Identification	Site Location	Completed in 1996		1997
				August	October	March
1	North	MW37	Downgradient	TAL/TCL		TAL/TCL
2		MW38	Downgradient	TAL/TCL		TAL/TCL
3		MW39	Side-gradient	TAL/TCL		TAL/TCL
4	East	MW11	Side-gradient		TAL/TCL	TAL/TCL
5		MW40	East of site	TAL/TCL		TAL/TCL
6		MW12			TAL/TCL	TAL/TCL
7		MW18			TAL/TCL	TAL/TCL
8	Southeast	MW47	Downgradient	TAL/TCL		TAL/TCL
9		MW41	southeast of landfill	TAL/TCL		TAL/TCL
10		MW42		TAL/TCL		TAL/TCL
11		MW43		TAL/TCL		TAL/TCL
12		MW44		TAL/TCL		TAL/TCL
13		MW19			TAL/TCL	TAL/TCL
14	Southwest	MW15	Southwest of landfill		TAL/TCL	TAL/TCL
15		M1S	Griffith Landfill	not sampled		TAL/TCL
16		M3S	Griffith Landfill	not sampled		TAL/TCL
24		M4S	Griffith Landfill	not sampled		TAL/TCL
17	Wetlands	MW14	Down-gradient		TAL/TCL	TAL/TCL
18		MW46	in wetland area	TAL/TCL		TAL/TCL
19		MW13			TAL/TCL	TAL/TCL
20	Plume Interior	MW48	North side of site	TAL/TCL		TAL/TCL
21		MW49	North side of site	TAL/TCL		TAL/TCL
22		MW6	southeast of landfill		TAL/TCL	TAL/TCL
23		MW45	southeast of landfill	TAL/TCL		TAL/TCL

**Notes:**

TCL Target Compound List (VOCs, SVOCs, pesticides & PCBs)

TAL Target Analyte List (Metals)

**G**

**SPECIFIC OPERATING PROCEDURE**

**LOW FLOW GROUNDWATER SAMPLING**

# **SPECIFIC OPERATING PROCEDURES**

(REVISED MARCH 21, 1997)

**American Chemical Service Inc.  
Griffith, Indiana**

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## **LOW FLOW GROUNDWATER SAMPLING**

**Subject:** Groundwater Monitoring Well Sampling

**Method:** Low Flow Sampling with Submersible Pump

### **I. PRE-FIELD CHECKLIST**

#### **A. Paperwork to take to the site**

1. Completed monitoring well construction summary for the wells to be sampled
2. Monitoring well development summary forms
3. Health and Safety Plan

#### **B. Equipment to take to the site**

1. Field Notebook
2. Watch, or timing device
3. Electronic water level indicator
4. 5-gallon bucket
5. Plan for disposal of water
6. Decon solutions and buckets
7. Flow Cell
8. Generator
9. Pump (Grundfos), generator, extension cord (50 feet)
10. Polyethylene tubing, hose clamps
11. Graduated container
12. Hand tools (socket set, hammer)
13. Sample bottles (EPA540/R93/051/Dec/92) and preservatives (HCL and HNO<sub>3</sub>)
14. Sample labels and tags
15. Well access (key)
16. Drums or poly tank for containing purge water
17. Cooler(s) with ice
18. Packing material (vermiculite, tape)
19. Chain of custody forms

## **II. LOW FLOW SAMPLING WITH SUBMERSIBLE PUMP**

- A. Measure and record depth to water from top of the well casing with electronic water level indicator. Examine the water level indicator for evidence of sheen, oily surface or other immiscible fluids and record this information in the field log book.**
- B. Measure and record total depth from top of well casing with electronic water level indicator.**
- C. Refer to monitoring well construction summary for depth to top of the well screen. Attach new, clean polyethylene tubing to the Grundfos pump. (Teflon® tubing was considered for sampling purposes but not selected due to its excessive rigidity which makes the tubing difficult to attach to the pump and handle while raising and lowering the pump in the well. This material is more ideally suited and typically utilized for dedicated well sampling systems, including bladder pumps or Waterra inertial lift pumps).**
- D. Lower the Grundfos pump so that the pump rests approximately in the center of the screen.**
- E. Begin purging the well at a rate of approximately 300 ml per minute. Confirm the purge rate by measuring the amount of water purged in one minute with a graduated measuring device, such as a bucket, or sample container. Observe the purge water for evidence of a sheen, oily surface or other immiscible fluids and record this information in the field log book.**
- F. While purging, field measurements for pH, specific conductance, temperature, and turbidity will be collected in-line using the flow cell.**
- G. When pH, specific conductivity, temperature, and turbidity readings have stabilized for three consecutive readings within 10% of the previous readings, sample bottles can then be filled. Samples collected for volatile organic analyses shall be filled first followed by the samples collected for metals analysis. Samples shall be placed in a cooler and iced immediately after collection.**
- H. Purge water will be contained by placing purge water into drums (steel or poly) at each well location, or by pumping into a poly holding tank which can be placed onto the back of a pickup truck. The purge water will be stored at the off-site containment area for staging following completion of sampling activities. If the water is contained in the poly tank during purging, the tank will then be moved to the off-site containment area and the water will be pumped into drums and staged for future disposal. Water will be carefully**

pumped into the drums with enough space left in the drums to allow for freezing of water without causing the drums to crack or leak.

- I. Upon completion of the sampling event, promptly remove the sampling pump from the well. Decontaminate the pump by inserting the pump into a container prepared with a distilled water and Alconox solution, followed by a distilled water rinse. Water generated during decontamination will be collected and containerized in 55-gallon drums. The drums will then be sealed, labeled and stored in the off-site containment area for future disposal.

### **III. SAMPLE LABELING AND TAGGING**

- A. Sample labels and tags are used in conjunction with chain-of-custody documents to ensure sample identification, preservation, and custody requirements are maintained. Each label and tag will be labeled with a sample identifier code as defined below.

A three letter designation will be used for identifying the sampling site. The project identifier will be "ACS," to signify the American Chemical Service, Inc. NPL site.

Each groundwater sample will be identified by a two letter code, "GW" to identify the sample as a groundwater sample from a monitoring well.

The sample type code will be followed by a 2-5 digit alpha-numeric code to indicate sample location. This code will correspond to monitoring well number (i.e., MW34).

For example, a groundwater sample collected from monitoring well MW-35 will have the following sample label: ACS-GW-MW35.

- B. Adhesive labels are used to identify all samples collected by Montgomery Watson personnel during field activities with the exception of samples collected for submittal to laboratories through the U.S. EPA Contract Laboratory Program (CLP) (federal lead investigation).

The adhesive label should be affixed to the sample container prior to sample collection. Condensation may form on containers after filling which would make it difficult to adhere labels.

U.S. EPA Sample Tags are used to identify all samples collected under the U.S. EPA Contract Laboratory Program (CLP). Tags are affixed to each to the bottles using a loop around the neck of the bottle. The information on the sample tag is filled in completely, with the sample identifier code described above.

#### **IV. SAMPLE COLLECTION AND PREPARATION**

A. All sample containers received from the laboratory will meet the specifications and protocols of U.S. EPA guidance document EPA540/R-93/051/12-92.

B. Volatile Organic Compounds

1. Remove the plastic cap and Teflon® coated septum being careful not to contact potential contaminants. If vial and/or cap appears to be defective, discard and use a new vial. The vial should be opened for a minimum amount of time. Three (3) vials must be collected for each sample.
2. Carefully fill the vial with continuous low flow from the pump with water until meniscus (mound of water) forms on the top. Avoid agitating the sample as this may cause a loss of volatiles. Add four drops of 1+1 hydrochloric acid (HCL) to the sample for preservation. HCL preservation may be added to the vial either before or after sample collection.
3. Carefully replace the cap on the meniscus. This will force a small amount of water off the top. Check the vial for air bubbles by inverting vial and gently tapping the side of the vial. Bubbles will rise to the top, if present. If bubbles are present, discard the vial and start with a new one. Place samples into cooler with ice upon sample completion.

C. Metals (Total Metals)

Complete metals sampling following collection of VOC sample while continuing to purge the well at 300 ml per minute. Fill 1-liter polyethylene container to the shoulder. Preserve with 3 ml, or until pH<2, of HNO<sub>3</sub>. Place sample into cooler with ice.

D. Semi-volatiles and PCBs

For sampling of semi-volatile organic compounds and PCBs, the flow rate may be increased to 600 to 1,000 ml/minute as long as there is no drawdown in the well and there is no increase in turbidity. This method will not change the intended benefit of low flow sampling for VOCs and metals and it will reduce the total time required to fill the necessary sample jars.

1. With the water level indicator in the well, increase the flow rate to 600 or 1,000 ml/minute. Select the flow rate that does not cause any increase in drawdown in the well.
2. Fill two 1-liter amber glass bottles to the shoulder for semi-volatile compounds and fill two 1-liter amber glass bottles to the shoulder for PCB/pesticide analysis.

3. No preservation is required for either semi-volatiles or PCBs. Therefore, upon completion of filling sampling bottles, immediately place the bottles in a cooler with ice.

## **V. DOCUMENTATION**

### **A. Field Notebook**

All sample collection activities will be documented in the field log book. The field log book will contain the following information:

1. Sampling location
2. Sample identification number
3. Date and time of collection
4. Depth to water
5. Purging rate and approximate volume purged
6. Field parameter measurements
7. Type(s) of sample containers
8. Field observations (weather, odor, sheen, etc.)
9. Name of sampling personnel
10. Preservation method
11. Analyses requested

### **B. Chain-of-Custody (COC) Forms**

1. The COC record will be used to document the samples taken and analyses requested. Information that field personnel will record on the COC record includes the following:
  - a. Project name
  - b. Sampling location
  - c. Printed name and signature of sampler
  - d. Sample identification number
  - e. Sample label number
  - f. Date and time of collection
  - g. Sample designation (QA/QC, grab or composite)
  - h. Sample matrix
  - i. Number and size of containers
  - j. Analyses requested
  - k. Signature of individual involved with custody transfer (including date and time of transfer)
2. COC records initiated in the field will be signed, placed in a plastic "zip-lock" bag, and secured inside of the shipping container used for sample transport. Signed air bills will serve as evidence of custody transport between the field sampler and courier as well as the courier and laboratory. Copies of the COC record and the air bills will be retained and filed by the sampler prior to shipment.

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